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Haessig

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(54) **METHOD FOR PRODUCING CORRUGATED BOARD PRODUCTS HAVING AN OBLIQUE FLUTE PROFILE**

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(58) **Field of Classification Search**
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See application file for complete search history.

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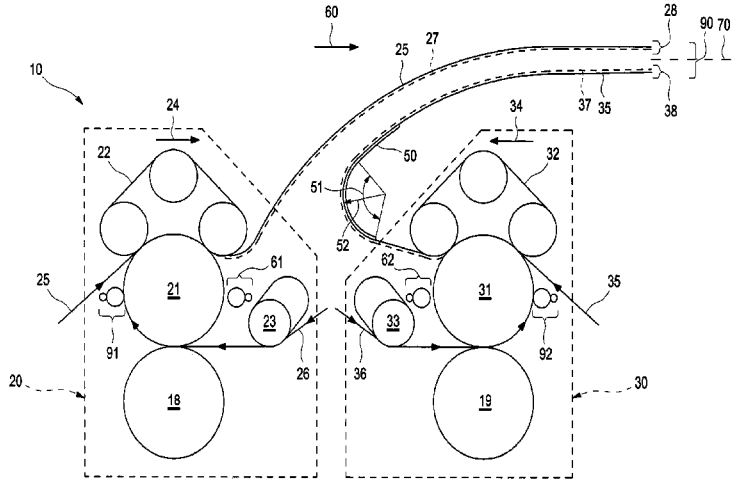
(57) **ABSTRACT**

The invention relates to a method and an apparatus for the production of a corrugated cardboard product. The apparatus comprises a first single facer and a second single facer which are provided in each case with a press-down belt and with a first and a second grooving roller respectively. The first and the second grooving roller are designed for embossing a wave profile onto a first and a second paper web respectively. The press-down belts, together with the respective grooving rollers, for connecting the first and the second paper webs in each case to a non-corrugated web for the production of a first and a second single-flute corrugated cardboard web respectively. The first single facer is equipped with a first oblique guide roller, the axis of rotation of which is inclined at a vertical inclination angle between side margins of the first paper web.

9 Claims, 7 Drawing Sheets



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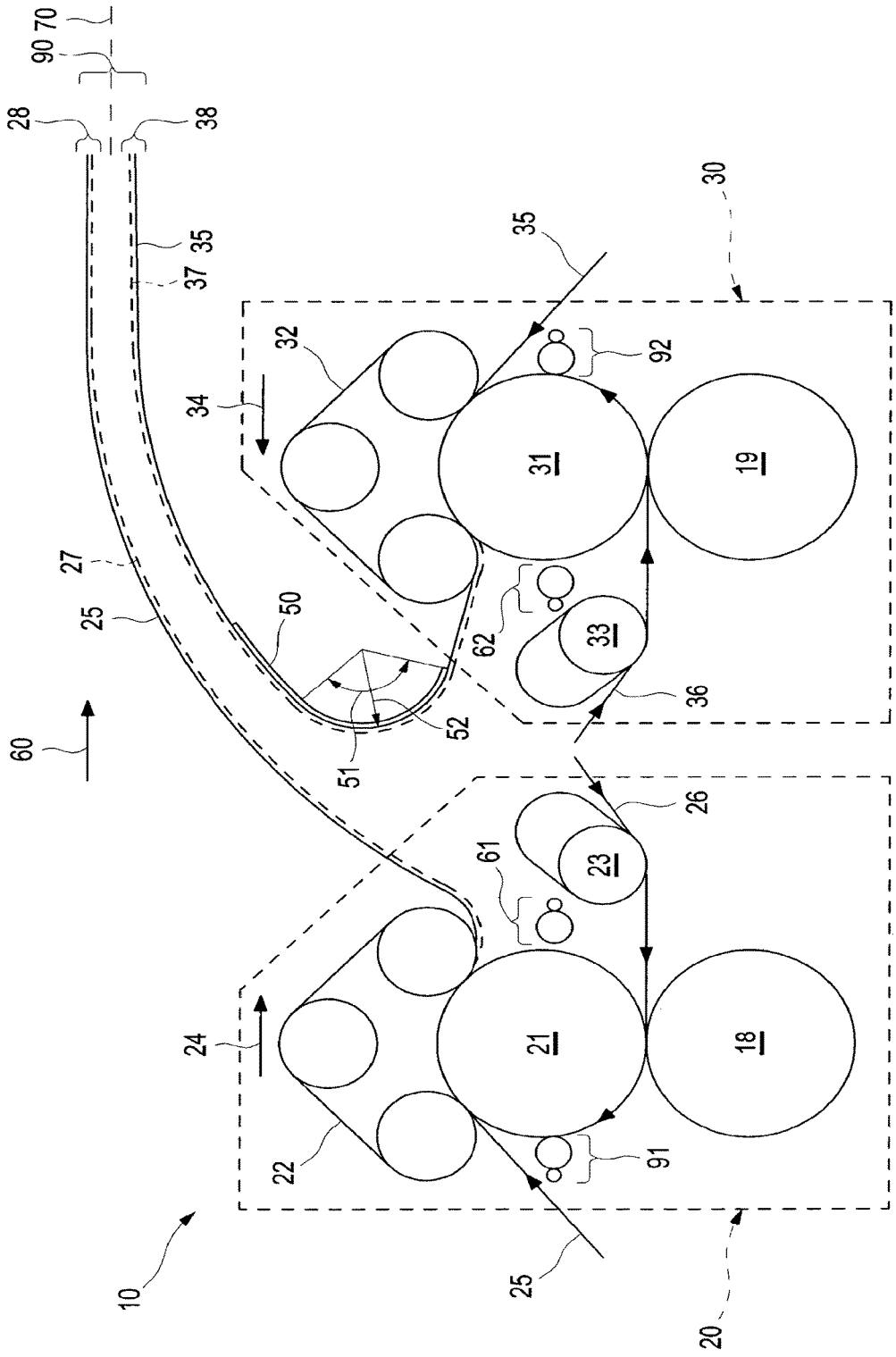
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Fig. 1

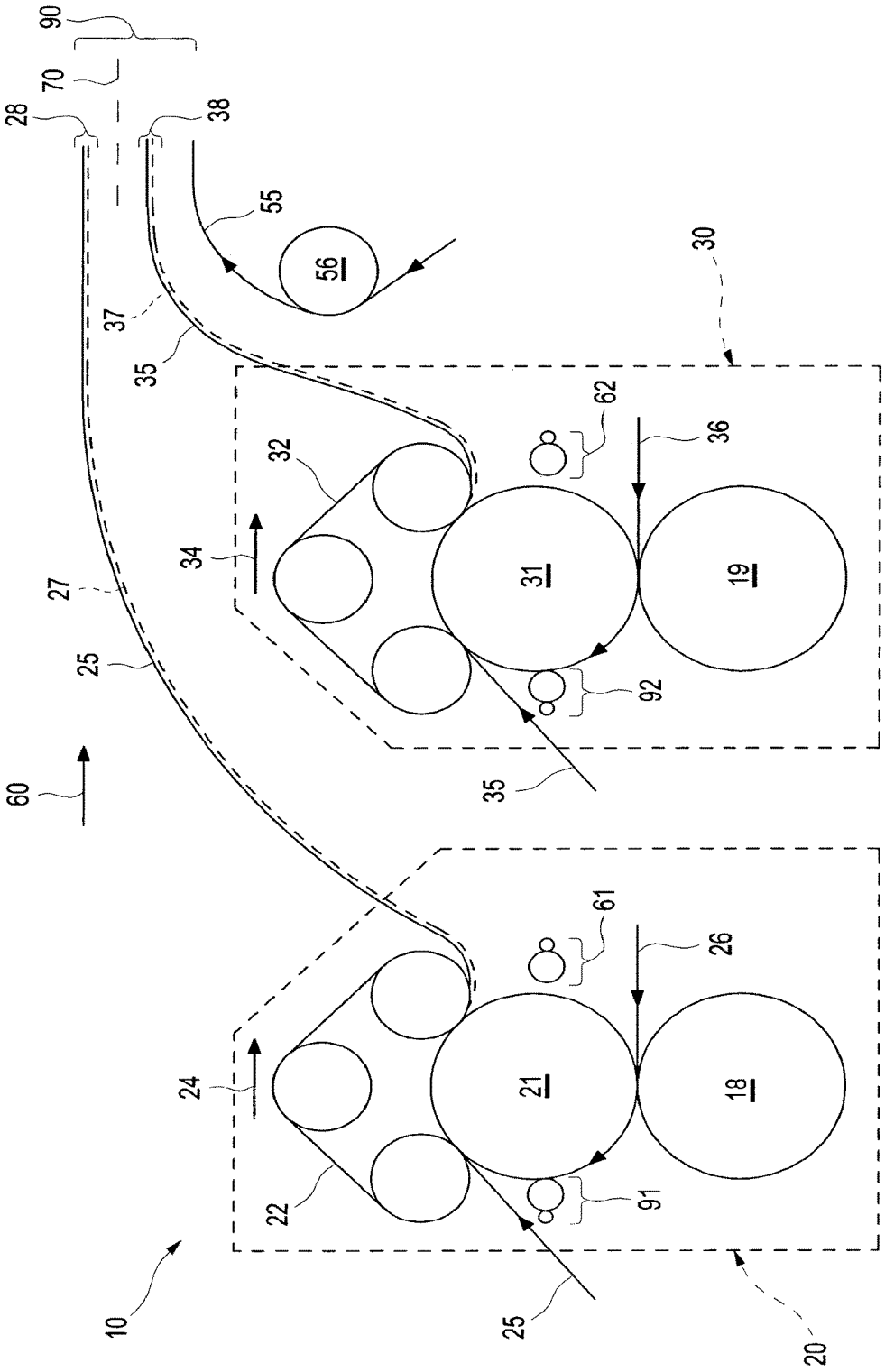
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Fig. 2

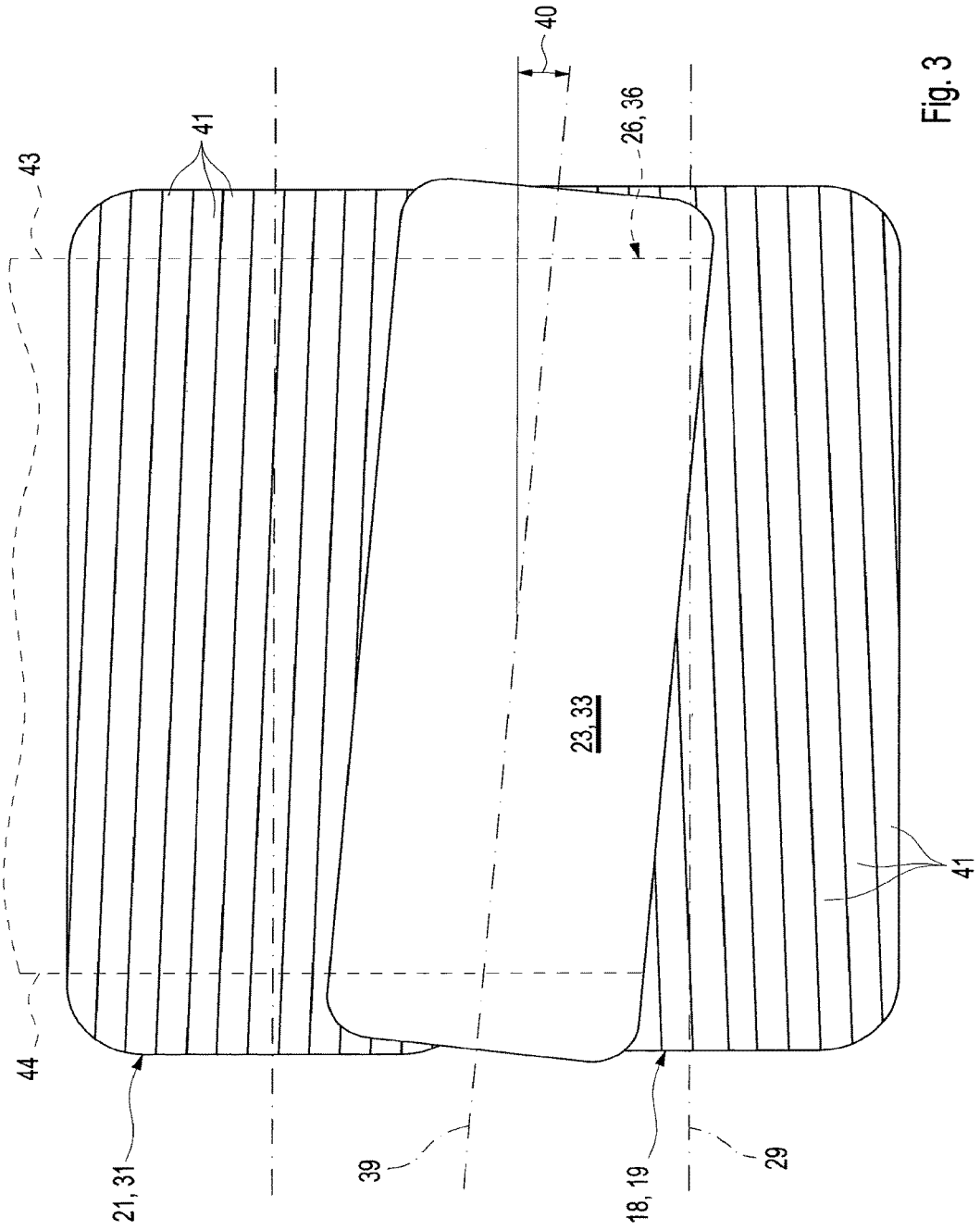


Fig. 3

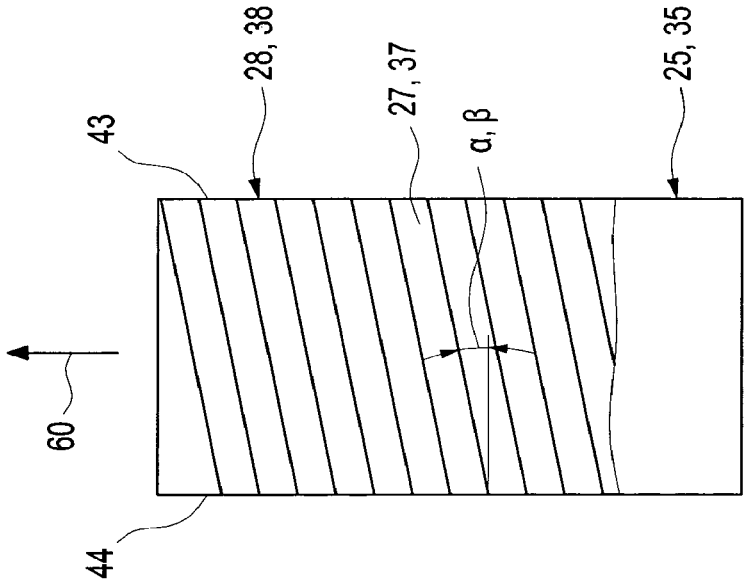
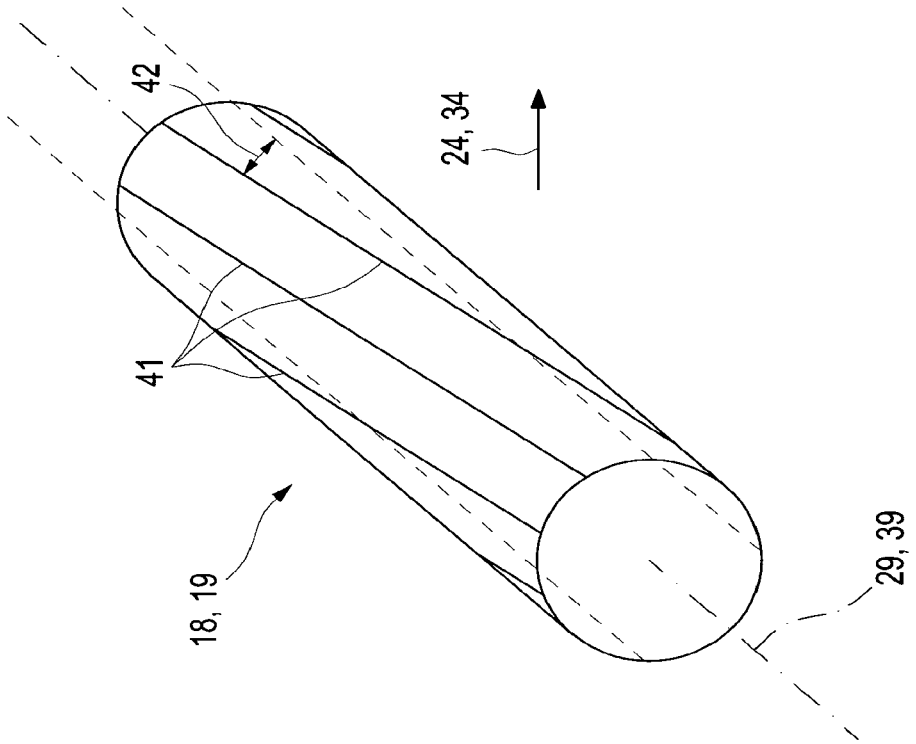


Fig. 5



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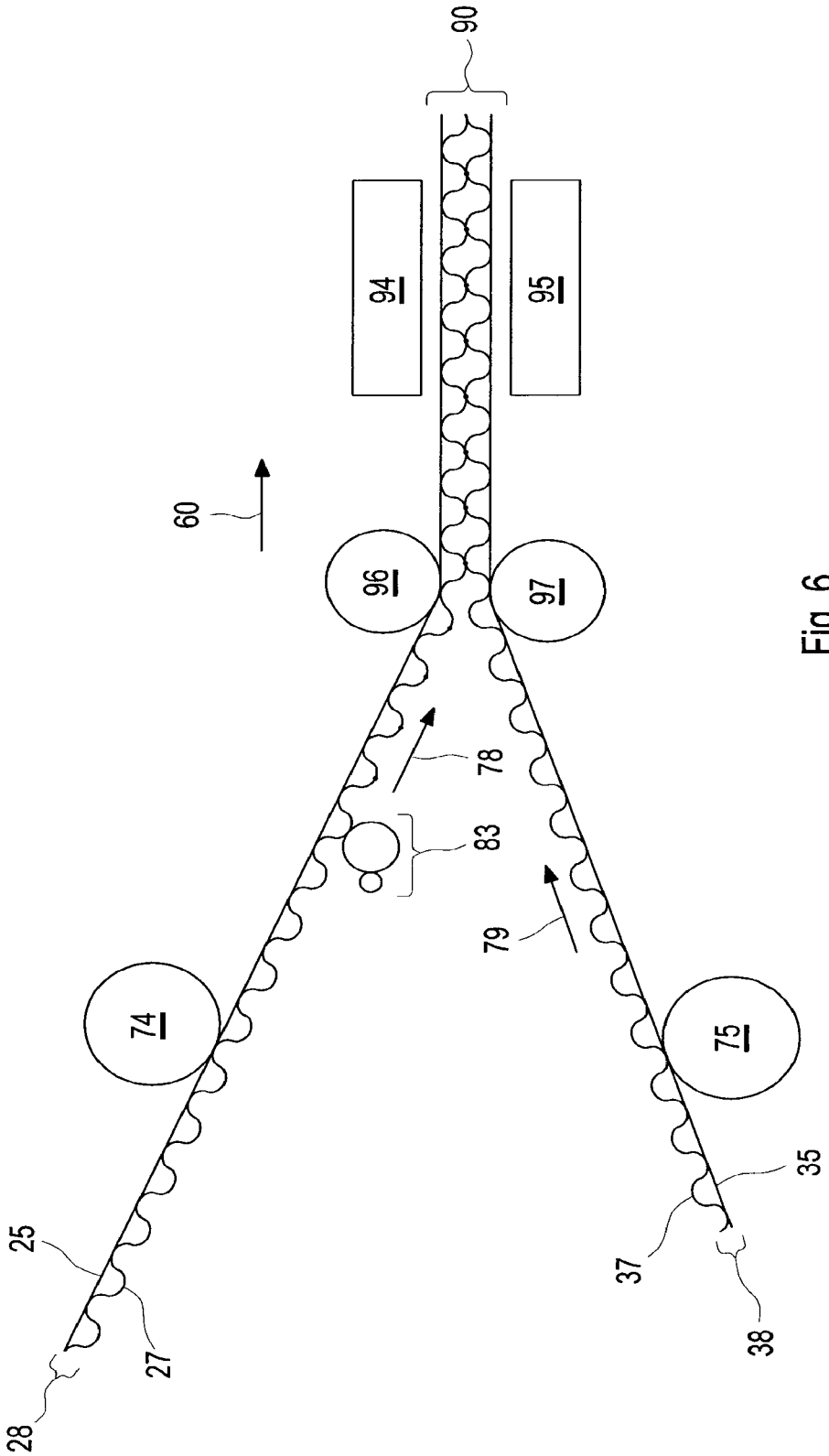

Fig. 6

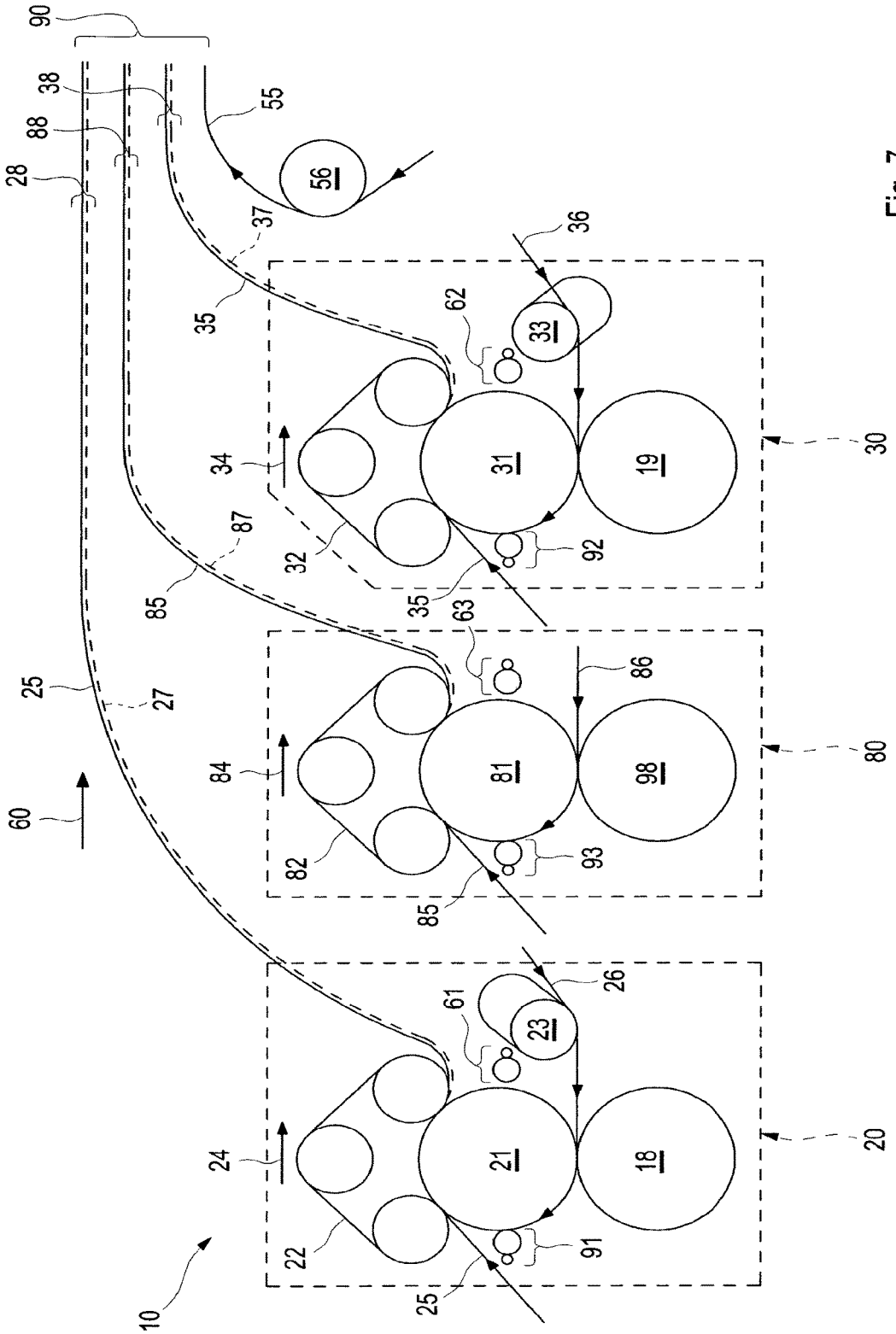
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Fig. 7

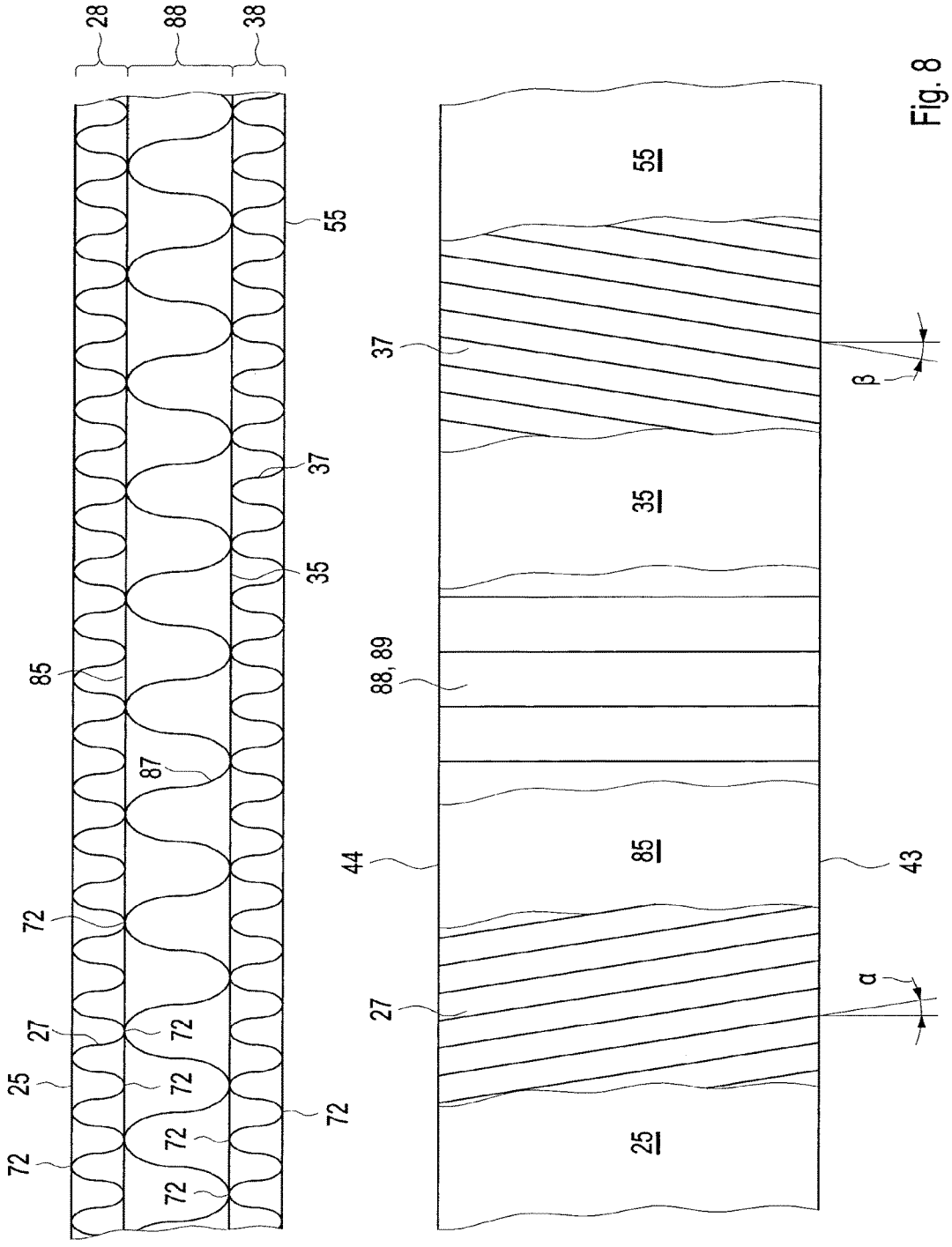
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Fig. 8

METHOD FOR PRODUCING CORRUGATED BOARD PRODUCTS HAVING AN OBLIQUE FLUTE PROFILE

The present invention is a divisional application of U.S. patent application Ser. No. 14/410,761, filed on Dec. 23, 2014, now U.S. Pat. No. 9,827,734, which is a national stage of PCT/EP2013/002019, filed on Jul. 5, 2013, which claims priority to European Patent Application No. 12004993.7, filed on Jul. 5, 2012. Each of these documents is incorporated herein by reference in its entirety.

TECHNICAL FIELD

The invention relates to an apparatus and a method for the production of corrugated cardboard products which serve, for example, as packaging material. Corrugated cardboard products are produced from individual paper webs, a corrugated cardboard product comprising smooth and corrugated paper plies which are connected to one another. Corrugated cardboard products are produced by a continuous method in machines which are equipped with paper reels and generate stacks of corrugated cardboards which can be processed further, for example, into packaging.

PRIOR ART

DE 1 561 510 discloses a method for the continuous production of stiff corrugated cardboard, in which two webs of corrugated cardboard having oblique corrugations are glued to one another. The webs having oblique corrugations are produced by a cardboard web being in each case led through between two coupled corrugating cylinders, the corrugating cylinders being manufactured with helical grooving. A cardboard web which is led through the coupled corrugating cylinders is brought, at an angle β, lying in a horizontal plane, with respect to the running direction of the corrugated cardboard machine, up to a smooth web and is glued to the latter. This gives rise to a composite web. Two composite webs are subsequently connected to one another in such a way that their corrugated sides are glued to one another without an intermediate ply. The disadvantage of the method according to DE 1 561 510 is that the apparatus required for it is designed only for corrugated cardboard without an intermediate ply between the composite webs. Other types of corrugated cardboard, in particular those with an intermediate ply, can be generated only after a complicated conversion of the apparatus used for this purpose. Furthermore, such apparatuses have a considerable width and take up a large amount of space.

PRESENTATION OF THE INVENTION

The object on which the present invention is based is to make available a possibility for producing corrugated cardboard products simply and cost-effectively. Furthermore, the object on which the present invention is based is to provide an apparatus and a method for the production of corrugated cardboard products, which can be changed over quickly and at low outlay between corrugated cardboard products having differing architecture. Moreover, the object on which the invention is based is to make available a space-saving apparatus for the production of corrugated cardboard products.

The apparatus according to the invention comprises a first single facer and a second single facer which are provided in each case with a press-down belt.

Furthermore, the single facers are equipped with a first and a second grooving roller which are designed in each case for embossing a wave profile into a paper web. The first single facer embosses a wave profile into a first paper web and the second single facer embosses a wave profile into a second paper web. The first and the second paper web are subsequently connected in each case to a non-corrugated web by means of a press-down belt. The first and the second paper web which are connected to a non-corrugated web form respectively a first and a second single-flute corrugated cardboard web. Moreover, the first single facer is equipped with a first oblique guide roller, of which the axis of rotation between side margins of the first paper web is inclined at a vertical inclination angle.

The connection of the first and the second paper web to the first and the second non-corrugated web respectively takes place advantageously by means of a press-down belt which makes it possible to act upon the connection of the individual plies with a high pressure pulse. The first and the second paper web are in this case connected respectively to the first and the second non-corrugated web by means of an adhesive. The application of the pressure pulse takes place by means of the press-down belt with a low pressure force, thus keeping the mechanical stress upon the processed paper webs low. The action of a low pressure force makes it possible to achieve a high degree of quality of the corrugated cardboard product. Furthermore, a press-down belt has low vibration during operation, so that the connection of the paper webs to the non-corrugated webs takes place with high geometric accuracy. The first oblique guide roller is advantageously mounted upstream of an entry of the first paper web into a nip of the first grooving roller. The first paper web is held in a tensioned state over its width by means of the first oblique guide roller. The tensioned state ensures that the first paper web is drawn exactly into a nip of the first grooving roller, with the result that the corrugation applied to the first paper web by the first grooving roller has a high degree of precision. This enables the width of the apparatus to be kept low and space to be saved. Wide oblique web guides are avoided. Alternatively, with the apparatus having a given construction width, the width of the processed paper webs can be increased. The quantity of corrugated cardboard product capable of being produced per unit time thereby rises.

Furthermore, the apparatus according to the invention may have a second single facer which is provided with a second oblique guide roller. The axis of the second oblique guide roller may be inclined at a vertical inclination angle between side margins of the second paper web. The second oblique guide roller may advantageously be mounted in the second single facer in such a way that the second paper web is guided via the second oblique guide roller before contact with the second grooving roller. The vertical inclination angle of the axis of the second oblique guide roller makes it possible to hold the second paper web in a tensioned state. The tensioned state of the second paper web ensures that the second paper web is drawn exactly into a nip of the second grooving roller, with the result that the wave profile applied by the second grooving roller has a high degree of precision. The vertical inclination angle of the axis of the second oblique guide roller makes it possible, furthermore, to guide the second paper web parallel to the second non-corrugated web and the running direction of the apparatus. As a result, the width of the apparatus is kept low; wide oblique web guides are avoided.

Moreover, in the apparatus according to the invention, the first and the second oblique guide roller can have which are

inclined at contradirectionally oriented vertical inclination angles. The orientation of the vertical inclination angle of the first and of the second oblique guide roller causes uniform tautening thereof from side margin to side margin. The vertical inclination angle of the first and of the second oblique guide roller corresponds essentially to the orientation of a grooving of the helical grooving rollers. This ensures a material-compatible feed of a paper web to a nip of a grooving roller, thus allowing exact processing of the paper webs.

Moreover, the apparatus may be provided with a first single facer which has a first web conveying direction which is opposite to a second web conveying direction of the second single facer. Opposite web conveying directions make it possible to bring the single-flute corrugated cardboard webs, produced by the single facers, together over a short length in the running direction of the apparatus. The apparatus according to the invention can thereby be kept short in a space-saving way.

Moreover, in the apparatus according to the invention, the second single facer may be provided with a deflection which is designed for deflecting the second single-flute corrugated cardboard web. The deflection makes available a simple and reliable possibility for rotating or turning a single-flute corrugated cardboard web. Especially advantageously, the second single-flute corrugated cardboard web is in contact with the deflection at a looping angle of 90° to 180°. Advantageously, further, the deflection is designed with a bending radius of 0.5 m to 1.5 m.

Such a large looping angle and such a large bending radius make it possible to have a material-protecting deflection of the second single-flute corrugated cardboard web. Furthermore, high dimensional stability of a corrugated web of the single-flute corrugated cardboard web is ensured. Distortion or deformation of the second single-flute corrugated cardboard web is thereby minimized, with the result that the achievable quality of the corrugated cardboard products rises. Preferably, the deflection is designed as a stationarily arranged guide plate or a stationarily arranged deflecting plate which deflects the second single-flute corrugated cardboard web in a radius of between 0.5 and 1.5 mm, so that, by virtue of the selected radii ranges, high mechanical load upon the first single-flute corrugated cardboard web is avoided.

Moreover, the apparatus according to the invention may be equipped with a first grooving roller which is provided with helical grooving. The helical grooving has a pitch angle with respect to the axis of rotation of the first grooving roller. The helical grooving having an pitch angle along the axis of rotation of the first grooving roller makes it possible to provide the first paper web with a wave profile which is oriented obliquely to the first web conveying direction. A helical grooving roller thus makes it possible, in a continuous production process, to provide a paper web in a simple way with a wave profile which allows material-saving and stiff corrugated cardboard architectures.

In a further advantageous embodiment, the pitch angle of the helical groove in the first grooving roller has the same orientation as the inclination angle of the first vertically inclined guide roller. In this case, the orientation of the pitch angle and of the vertical inclination angle relate, as seen in a conveying direction of the first or of the second paper web, to a conveying plane of the first or the second paper web. Furthermore, in an advantageous embodiment of the apparatus according to the invention, the pitch angle of the helical grooving of the first grooving roller and the inclination angle of the first vertically inclined guide roller are essentially of equal size. This ensures a high degree of processing precision for the corrugated cardboard product to be produced. Furthermore, this avoids one-sided mechanical overstressing of the paper web, which may cause the web to tear. The reliability of the apparatus according to the invention is thereby increased. Furthermore, in the same way, the apparatus according to the invention may be equipped with a second grooving roller which has helical grooving. In this case, the helical grooving of the second grooving roller has a pitch angle with respect to the axis of rotation.

In a further advantageous embodiment, the pitch angle of the helical grooving of the second grooving roller has the same orientation as the inclination angle of the second vertically inclined guide roller. The orientation of the pitch angle and of the vertical inclination angle in this case relate, as seen in a conveying direction of the first or of the second paper web, to a conveying plane of the first or of the second paper web. The size of the pitch angle of the helical grooving and the inclination angle of the second vertically inclined guide roller may in this case be essentially identical. The same technical advantages as in the case of the first grooving roller and of the first vertically inclined guide roller are afforded. In an advantageous embodiment, in which in each case the first vertical inclination angle corresponds in orientation and size to the helical pitch angle of the first grooving roller and the second vertical inclination angle corresponds in orientation and size to the helical pitch angle of the second grooving roller, a high degree of processing precision in the desired corrugated cardboard product is achieved.

Furthermore, the apparatus according to the invention may have a first grooving roller with helical grooving, the pitch angle of which matches with an offset angle α by which a corrugation of the first single-flute corrugated cardboard web is offset. Moreover, the second grooving roller with helical grooving may have a pitch angle which matches with an offset angle β by which the corrugation of the second single-flute corrugated cardboard web is offset. The achievable accuracy of the offset angles α and β corresponds to the manufacturing precision with which the first and the second grooving roller are produced. The offset angles α and β can thereby be set exactly in the corrugated cardboard architecture. Corrugated cardboard architectures which fully utilize the strength of the paper employed can thereby be implemented. As a result, with a view to a lightweight construction, material-saving and stable corrugated cardboard architectures, the strength of which is increased even further in the form of a composite corrugated cardboard structure, can be implemented. This refers particularly to corrugated cardboard architectures, in which the offset angles α and β have different amounts or orientations and thereby form grid-shaped structures, for example, in a parting plane running centrally.

Advantageously, further, the apparatus according to the invention may have a feed roller which is suitable for bringing up an additional paper web. The feed roller can be integrated in a simple way into a machine design diagram if the apparatus is to be set up for the production of a corrugated cardboard product which requires an additional paper web, for example an intermediate ply. Furthermore, the feed roller can be deactivated in the apparatus in a simple way if the apparatus is to be set up for the production of corrugated cardboard products which comprise only single-flute corrugated cardboard webs.

Furthermore, in the apparatus according to the invention, the second single facer may be designed to operate in opposite operating directions. In this case, the operating

direction of the second single facer may be reversed. It is thereby possible at low outlay to modify the machine design diagram of the apparatus according to the invention. Modification of the machine design diagram makes it possible to vary the sequences of a production process carried out by the apparatus and to implement different configurations of the apparatus. The production process carried out by the apparatus can thus be adapted at low outlay to different corrugated cardboard products to be produced. As a result, the apparatus according to the invention has a broad range of use and allows the cost-effective production of the corrugated cardboard product to be produced, while at the same time having short conversion times.

Moreover, the apparatus according to the invention may be equipped with a third single facer which serves for the production of a third single-flute corrugated cardboard web. In this case, the third single facer has a third grooving roller which is designed for embossing a wave profile onto a third paper web. The use of a third single facer makes it possible by means of the apparatus according to the invention to produced corrugated cardboard architectures which have increased complexity. The apparatus according to the invention can thus produce a larger number of corrugated cardboard products, so that the range of use is broadened. Furthermore, complex corrugated cardboard architectures make it possible to adapt the strength and stiffness of the desired corrugated cardboard product exactly to the intended use. Conversion to the configuration with the third single facer can be carried out in a short conversion time. In this case, rapid changes between two configurations are possible, and effective conversion times of a few minutes can be implemented. The apparatus according to the invention makes available a possibility for producing adapted, efficient and viable corrugated cardboard products in a simple way.

Furthermore, in the apparatus according to the invention at least one of the single facers may be provided in each case with a glue applicator roller. A glue applicator roller ensures simply and reliably a stable connection of the paper webs and non-corrugated webs which are connected to form single-flute corrugated cardboard webs.

The invention relates, furthermore, to a method for the production of corrugated cardboard products, an apparatus being used which comprises a first single facer with a first web conveying direction and a second single facer with a second web conveying direction. The method according to the invention in this case comprises the following steps:

In a first step, a first single-flute corrugated cardboard web is produced by means of the first single facer. In a further step, a second single-flute corrugated cardboard web is produced by means of the second single facer. During these steps, a first and a second paper web are guided respectively to a first and a second grooving roller. Before contact of the first and the second paper web respectively with the first and the second grooving roller, the first and the second grooving roller are steered in each case via a first and a second oblique guide roller. In a further step, the first single-flute corrugated cardboard web and the second single-flute corrugated cardboard web are brought together. In a subsequent step, the first and the second single-flute corrugated cardboard web are joined together and connected to one another in the region of a central parting plane to form the desired corrugated cardboard product. In the method according to the invention, the use of oblique guide rollers ensures that the first and the second paper web, in a portion before entry into a nip, are in a tensioned state respectively between the first and the second grooving roller and their respective counterpieces. Folding or creasing of the paper webs is thereby counteracted and failures of the apparatus are avoided. Furthermore, the tensioned state makes it possible to introduce the first and the second paper web precisely into the respective nip of the first and the second grooving roller, thus always ensuring a precise corrugation of the first and the second paper web. As a result, the achievable geometric exactness of the single-flute corrugated cardboard webs is increased and the quality of the corrugated cardboard product is improved.

In the method according to the invention, advantageously, the first and/or the second oblique guide roller may be inclined at a vertical inclination angle between side margins of the first and of the second paper web. The vertical inclination angle makes it possible to feed the first and the second paper web to the grooving rollers in parallel respectively with a first and a second web conveying direction of the first and the second single facer and with the running direction of the apparatus.

Furthermore, in the method according to the invention, a first single facer will be used which has a first web conveying direction which is opposite to a second web conveying direction of the second single facer. Opposite web conveying directions make it possible to bring the single-flute corrugated cardboard webs, produced by the single facers, together over a short length in the running direction of the apparatus.

Moreover, in an apparatus, the method according to the invention may be equipped with a first grooving roller which is provided with helical grooving. The helical grooving with a pitch angle along the axis of the first grooving roller makes it possible to provide the first paper web with corrugation which is oriented obliquely to the first web conveying direction. A helical grooving roller thus makes it possible in a simple way, in a continuous production process, to provide a paper web with a wave profile which allows material-saving and stiff corrugated cardboard architectures.

Furthermore, in the method according to the invention, a second grooving roller which has helical grooving may be provided in the same way.

Furthermore, in the method according to the invention, a first grooving roller with helical grooving may be used, the pitch angle of which determines an offset angle α by which the wave profile of the first single-flute corrugated cardboard web is offset upon exit from the first single facer. Moreover, the second grooving roller with helical grooving may likewise have a pitch angle which determines the offset angle β by which the wave profile of the second single-flute corrugated cardboard web is offset upon exit from the second single facer. The achievable accuracy of the offset angles α and β corresponds to the manufacturing precision with which the first and the second grooving roller are produced. The offset angles α and β can thereby be set exactly in the corrugated cardboard architecture.

As a result, corrugated cardboard architectures which fully utilize the strengths of the paper employed can be implemented. Consequently, with a view to lightweight construction, material-saving, efficient and stable corrugated cardboard architectures can be implemented. This refers particularly to corrugated cardboard architectures, in which the offset angles α and β have different amounts or orientations and thereby form grid-shaped structures in a central parting plane.

Furthermore, in the method according to the invention, the connection of the first and the second single-flute corrugated cardboard web may take place in such a way that the corrugated webs of the single-flute corrugated cardboard webs are glued to one another. This ensures direct contact of

the corrugated webs and avoids the use of an additional paper ply between the corrugated webs. Corrugated cardboard architectures without an additional paper ply between the corrugated webs can, with otherwise identical parameters, have a more favorable ratio of stiffness to weight. Furthermore, avoiding the need for paper ply in a corrugated cardboard product entails a considerable cost benefit and the saving of resources.

The invention relates, furthermore, to a corrugated cardboard product which comprises a first, a second, a third and an additional non-corrugated web. Moreover, the corrugated cardboard product according to the invention comprises a first, a second and a third corrugated web which lie in each case between two non-corrugated webs.

In this case, the corrugated cardboard product according to the invention has in the third corrugated web a wave profile which stands essentially at right angles to side margins of the corrugated cardboard product. A wave profile oriented in this way ensures high dimensional stability of the corrugated cardboard product under compressive load. Distortions are minimized. Moreover, the corrugated cardboard product according to the invention is provided with a first corrugated web which has a wave profile which is inclined at an offset angle α to side margins of the corrugated cardboard product. A wave profile, inclined at an offset angle α, of a corrugated web gives the corrugated cardboard product increased bending resistance. Furthermore, in the same way, the corrugated cardboard product according to the invention may be equipped with a second corrugated web, the wave profile of which is inclined at an offset angle β to side margins of the corrugated cardboard product. Wave profiles which are inclined at an offset angle α and/or p increase the longitudinal bending resistance of the corrugated cardboard product.

In an advantageous embodiment of the corrugated cardboard product according to the invention, the third corrugated web has a greater flute height than the first and the second corrugated web. The flute height of a corrugated web determines the stiffness and consequently the bending behavior of a corrugated cardboard product. Furthermore, the flute height of a corrugated web determines the stackability of packaging which can be produced from the corrugated cardboard product.

The use of corrugated webs having a different flute height makes it possible to set exactly the stiffness and strength of the corrugated cardboard product to be produced. This adaptability enables the corrugated cardboard products according to the invention to be optimized in terms of a multiplicity of possible uses. The corrugated cardboard product according to the invention is efficient and viable with a view to light weight construction.

In a further advantageous embodiment of the corrugated cardboard product according to the invention, in at least one plane of a web longitudinal section, the head points of the first and the second corrugated web are in contact, in the region of head and foot points of the third corrugated web, with the third and the second non-corrugated web respectively. Mechanical loads which are introduced into the first and second corrugated web are transferred respectively to the head and the foot points of the third corrugated web. The introduction of a mechanical load into a head or foot point of a corrugated web enables the pressure stability of the latter to be utilized optimally. Pressure loads which act upon the corrugated cardboard product according to the invention are thus introduced into the pressure-stable third corrugated web, and deformations of the corrugated cardboard product at the side margins are reduced. The corrugated cardboard product according to the invention is efficient with a view to lightweight construction and ensures optimal utilization of the material properties of the paper webs employed.

BRIEF DESCRIPTION OF THE FIGURES

The invention is described in more detail below by means of the drawing in which:

FIG. **1** shows a first configuration of a first single facer and of a second single facer, the single-flute corrugated cardboard webs generated in each case facing one another with their corrugated webs,

FIG. **2** shows a second configuration of the first single facer and of the second single facer, the two single-flute corrugated cardboard webs produced running codirectionally and an additional non-corrugated web being fed separately,

FIG. **3** shows a grooving roller with a counterpiece which is assigned an oblique guide roller,

FIG. **4** shows a perspective top view of a grooving roller having helical grooving,

FIG. **5** shows a top view of the single-flute corrugated cardboard webs having an offset wave profile,

FIG. **6** shows a side view of the bringing together of two single-flute corrugated cardboard webs to form a corrugated cardboard product,

FIG. **7** shows a third arrangement of a first facer with a second and third single facer, in which three single-flute corrugated cardboard webs are connected to form a corrugated cardboard product,

FIG. **8** shows a set-up of a corrugated cardboard product which comprises three corrugated webs, the wave profiles of which are offset differently.

DESIGN VARIANTS

A first possibility for the arrangement of a first single facer and a second single facer, from which in each case single-flute corrugated cardboard webs are conveyed away, in each case with their corrugated webs lying opposite one another, may be gathered from FIG. **1**.

A first single facer **20** comprises a first grooving roller **21** and its counterpiece **18** and also a first press-down belt **22** which is assigned to this first grooving roller **21** and which revolves via a plurality of deflecting rollers **96**, **97** and part of which wraps around the circumference of the first grooving roller **21**. On the entry site, the first grooving roller **21** of the first single facer **20** a first oblique guide roller **23** may be gathered. As indicated in FIG. **1** by the perspective reproduction of the first oblique guide roller **23**, the latter is set obliquely with respect to the vertical in relation to the feed plane of a paper web **26**.

The entering paper web **26** first passes over the circumference of the first oblique guide roller **23**, is deflected by the latter and runs, in the deflected pretensioned state, into the nip between the first grooving roller **21** and its counterpiece **18**. At the same time, a first non-corrugated web **25**, which remains non-corrugated, runs onto the circumference of the first grooving roller **21** and covers the top side of the paper web **26** running off from the circumference of the first grooving roller **21** and then having a corrugated profile. The two webs, that is to say the first non-corrugated web **25** and the then corrugated web **27**, pass through the press-down nip between the revolving first press-down belt **22** and the circumference of the first grooving roller **21**. A first single-flute corrugated cardboard web **28**, which comprises the first non-corrugated web **25** and the corrugated web **27**, runs in

a first web conveying direction **24** out of the first single facer **20** in a vertically S-shaped arc.

As may be gathered, moreover, from the illustration according to FIG. **1**, the apparatus proposed according to the invention comprises, furthermore, a second single facer **30**. Similarly to the first single facer **20**, the second single facer **30** comprises a second grooving roller **31**. The second grooving roller **31** cooperates with its counterpiece **19**. A paper web **36** runs into a nip, which is formed by the circumference of the second grooving roller **31**, and is pretensioned and deflected by a second oblique guide roller **33** which is set obliquely with respect to the vertical conveying plane. The second paper web **36**, which passes over the second oblique guide roller **33**, is provided with a wave profile in the nip between the second grooving roller and its counterpiece **19**. Then, the second paper web **36**, as a corrugated web **37**, together with a second non-corrugated web **35**, which is likewise conveyed the in the direction onto the circumference of the second grooving roller **31**, leaves the second single facer as a second single-flute corrugated cardboard web **38** after passing over the second press-down belt **32**. The second single-flute corrugated cardboard web **38**, after leaving the second single facer **30**, is guided via a deflection **50**. The deflection **50** is, in particular, a stationarily formed deflection **50** in the shape of a deflecting plate or guide plate. What is achieved by the deflection **50** is that the freshly generated second single-flute corrugated cardboard web **38**, comprising the second non-corrugated web **35** and the corrugated web **37**, is deflected under minimal mechanical stress into a running direction **60**. For this purpose, the deflection has a radius, selected relatively large, which lies preferably in a range of between 0.5 m and 1.5 m, in order to ensure as uniform a conveying path as possible which brings about only minor mechanical stresses in the second single-flute corrugated cardboard web **38**.

After leaving the second single facer **30**, the first single-flute corrugated cardboard web **28**, with its corrugated web **27** pointing downward, and the freshly generated second single-flute corrugated cardboard web **38**, with its corrugated web **37** pointing upward, lie opposite one another. The then generated single-flute corrugated cardboard webs **28** and **38** can then be brought together in a central parting plane **70**, so as to give rise to a corrugated cardboard product which manages without an intermediate ply. At the wave profiles, offset to one another, of the corrugated webs **27** and **37** pointing toward one another, connected in a materially integral manner, preferably glued together. This gives rise to a corrugated cardboard product **90** which is distinguished by high mechanical stability. The corrugated cardboard product **90** acquires high mechanical stability due to the fact that an offset grid pattern is obtained between the single-flute corrugated cardboard webs **28**, **38** because of the helical grooving **41** on the circumference of the two grooving rollers **21**, **31**.

A further configuration of the apparatus proposed according to the invention, which comprises a first single facer **20** and a second single facer **30**, may be gathered from the illustration according to FIG. **2**.

It is apparent from the illustration according to FIG. **2** that the first single facer **20** according to the illustration in FIG. **2** is constructed in a similar way to the first single facer **20** according to the design variant in FIG. **1**. FIG. **2** shows that the first grooving roller **21** arranged in the first single facer **20** is assigned the first press-down belt **22**.

Furthermore, the first grooving roller **21** is assigned a counterpiece **18**, so that these form a nip, in front of which a first oblique guide roller **23** is arranged. By means of the oblique guide roller, the first paper web **26** is tensioned and deflected. Furthermore, the first non-corrugated web **25** runs into the press-down nip between the first press-down belt **22** and the circumference of the first grooving roller **21**. As a result of helical grooving **41** on the circumference of the first grooving roller **21**, the entering paper web **26** gives rise to the corrugated web **27** which has an offset wave profile. The first single-flute corrugated cardboard web **28**, which comprises the first non-corrugated web **25** and the then corrugated web **27**, runs out of the first single facer **20**. It can be gathered from the illustration according to FIG. **2** that the first single-flute corrugated cardboard web **28** runs toward a central parting plane **70** in the running direction **60**.

In the configuration, illustrated in FIG. **2**, of the second single facer **30**, the second non-corrugated web **35** runs in the same direction as the first non-corrugated web **25** onto the circumference of the second grooving roller **31**. Moreover, the second paper web **36** runs in the same direction as the first paper web **26** into the nip between the second grooving roller **31** and its counterpiece **19**. The second oblique guide roller **33** is assigned to the paper web **36** in front of this nip on the web entry side. As a result of this, second single-flute corrugated cardboard web **38** leaves the second single facer **30** in the second web conveying direction **34** which is identical to the running direction **60** and to the first web conveying direction **24**.

Furthermore, it may be gathered from the illustration according to FIG. **2** that, in this configuration, a feed roller **56** is provided, via which an additionally non-corrugated web **55** runs off and the corrugated web **37** is brought up, so as to form a corrugated cardboard product **90** which comprises the first non-corrugated web **25**, the corrugated web **27**, the second non-corrugated web **35**, the corrugated web **37** and the additional non-corrugated web **55** brought up via the feed roller **56**. A five-ply corrugated cardboard product **90** with two corrugated webs **27**, **37** is obtained.

In the machine configurations according to FIGS. **1** and **2** for the first and the second paper webs **26**, **36**, in each case the first and the second oblique guide roller **23**, **33** are arranged. These tauten the still non-corrugated paper webs **26** and **36**, so that these run, pretensioned, onto the circumferential surfaces of the first and second grooving roller **31** which have in each case helical grooving **41**. This gives rise in each case to the wave profile, illustrated in FIG. **5**, in the first and the second single-flute corrugated cardboard web **28**, **38** with the offset angles α, β.

Whereas, in the machine configuration according to FIG. **1**, a deflection **50** is required downstream of the second single facer **30**, in the configuration according to FIG. **2** there is no need for this on account of the corresponding conveying directions of the non-corrugated webs **25**, **35** and of the paper webs **26**, **36**. In the configuration illustrated in FIG. **1**, single-flute corrugated cardboard webs **28**, **38** are provided in the central parting plane **70** for a four-ply corrugated cardboard product **90** without an intermediate ply.

FIG. **2** illustrates the generation of a five-ply corrugated cardboard product **90** having the additional non-corrugated web **55**.

FIG. **3** shows a top view of an oblique guide roller **23** or **33** which lies upstream of a grooving roller **21** or **31**.

It may be gathered from FIG. **3** that the oblique guide rollers **23** and **33**, which are arranged upstream of the grooving rollers **21** and **31**, are deflected at an inclination angle **40** with respect to the axis of rotation **29** or **39** of the grooving roller **21** or **31**. The paper webs **26** and **36**, when they pass over the oblique guide rollers **23** and **33**, undergo

deformation or pretensioning and run tautened onto the circumferential surfaces of the grooving rollers **21** and **31**. The helical grooving **41** runs at a pitch angle **42** which is also illustrated in the perspective view according to FIG. **4**.

The grooving rollers **21**, **31** are in each case mounted on a counterpiece **18**, **19**, with which they form in each case a nip. The nip is concealed in FIG. **3** by the guide roller **23**, **33**.

The pitch angle **42** determines the orientation of the wave profile which is embossed onto the first and the second paper web **26**, **36** by the first and the second grooving roller **21**, **31** respectively. After running through the press-down nip of the press-down belt **22**, **32**, the paper web **26**, **36** forms the corrugated web **27**, of the first and second single-flute corrugated cardboard web **28**, **38**, as illustrated in FIG. **5**. The orientation and size of the inclination angle **40** of the guide rollers **26**, **36** and the orientation and the size of the pitch angle **42** of the helical grooving rollers **21**, **31** may be changed, depending on the configuration required.

A perspective top view of one of the grooving rollers **21** and **31** may be gathered from the illustration according to FIG. **4**.

FIG. **4** shows that a helically running grooving **41** is formed on the circumference of the grooving roller **21** or **31**. As indicated in FIG. **4**, there is a pitch angle **42** with respect to a line, depicted by dashes, parallel to the axis of rotation **29** or **39** of the grooving roller **21** or **31**. The pitch angle **42** preferably lies between 0° and 13°, especially preferably between 3° and 10°.

The arrow, which is designated by the reference symbol **24** and **34**, designates the web conveying directions in which the first and the second single-flute corrugated cardboard web **28**, **38** emerge from the first and the second single facer **20**, **30**.

FIG. **5** shows a top view of the single-flute corrugated cardboard web **28**, **38**. It may be gathered from the illustration according to FIG. **5** that the single-flute corrugated cardboard webs **28** and **38** running in the running direction **60** comprise in each case corrugated webs **27** and **37** and in each case non-corrugated webs **25** and **35**. In FIG. **5**, the corrugated web **27**, **37** conceals the non-corrugated webs **25**, **35**. The wave profile of the corrugated webs **27**, **37** is offset by the offset angles α and β with respect to the side margins **43**, **44**. The offset angles α, β are determined by the pitch angle **42** of the grooving rollers **21** and **31** of the first and the second single facer and their counterpieces **18**, **19**. Lateral margins of the paper webs **26**, **36**, which, after emerging from the first and the second single facer **20**, **30**, form the corrugated web **27**, of the first and of the second single-flute corrugated cardboard web **28**, **38**, define the side margins **43**, **44** as the first and the second single-flute corrugated cardboard web **28**, **38** and of the corrugated cardboard product **90**.

FIG. **6** illustrates the bringing together of a first single-flute corrugated cardboard web **28** with a second single-flute corrugated cardboard web **38**. The first single-flute corrugated cardboard web, which comprises a first non-corrugated web **25** and a first corrugated web **27**, is in this case guided along at a first regulating roller **74**. Furthermore, the single-flute corrugated cardboard web **28** is deflected at a first deflecting roller **96**. In the bringing together according to FIG. **6**, the second single-flute corrugated cardboard web **38**, which comprises a second corrugated web **37** and a second non-corrugated web **35**, is guided along at a second regulating roller **75** and is deflected at a second deflecting roller **97**. The conveyance of the first single-flute corrugated cardboard web takes place in a first conveying direction **78** and the conveyance of the second single-flute corrugated cardboard web **38** takes place in a second conveying direction **79**. The single-flute corrugated cardboard webs **28**, **38** are brought together in the region of the deflecting rollers **96**, **97** to form a corrugated cardboard product **90**. The corrugated cardboard product **90** is transported further along a running direction **60**. Moreover, a glue applicator unit **83** is mounted in the bringing-together region and provides head points of the corrugated web **27** with an adhesive. The adhesive applied by glue applicator unit **83** ensures that the first and the second single-flute corrugated cardboard web **28**, **38** are connected to form the corrugated cardboard product **90**. Furthermore, the first and second single-flute corrugated cardboard web **28**, **38** are joined together in such a way that the head points of the first and the second corrugated web **27**, touch one another in the corrugated cardboard product **90**. For the further processing of the corrugated cardboard product, further processing devices **94**, **95** are formed downstream of the deflecting rollers **96**, **97**, as seen in the running direction **60**. A processing device **94**, **95** may be designed as a press-down plate, heating plate, press-down belt or the like.

The processing devices serve for stabilizing the corrugated cardboard product **90**.

FIG. **7** shows diagrammatically a preferred embodiment of the apparatus **10** according to the invention. This comprises a first single facer **20** which has a first grooving roller **21** with a counterpiece **18**. The first grooving roller **21** and its counterpiece **18** form a nip, into which a first paper web **26** is introduced. The first grooving roller **21** has grooving (not illustrated), by means of which a wave profile is embossed onto the first paper web **26**. Moreover, the first single facer has a first oblique guide roller **23**, around which the first paper web **26** is guided. The first oblique guide roller **23** is mounted at a vertical inclination angle and ensures taut guidance of the first paper web **26**. Furthermore, the first single facer **20** has a pair of glue applicator rollers **91** providing one side of the first paper web **26** with adhesive. The first single facer **20** is equipped with an additional glue applicator unit **61** which, in FIG. **7**, is not in engagement. The additional glue applicator unit **61** makes it possible to convert the first single facer **20**. Moreover, the first single facer **20** has a first press-down belt **22** which bears against the first grooving roller **21**. The first paper web **26** provided with a wave profile and a first non-corrugated web **25** are introduced into the nip between the first press-down belt **22** and the first grooving roller **21**. The first press-down belt **22** connects the first paper web **26** to the non-corrugated web **25** and from these forms a first single-flute corrugated cardboard web **28**. The first single-flute corrugated cardboard web comprises the first non-corrugated web **25** and a corrugated web **27** which arises from the first paper web **26**. The first single facer **20** has a first web conveying direction **24** which is codirectional to the running direction **60** of the apparatus **10** according to the invention.

Moreover, the arrangement, illustrated in FIG. **7**, of the apparatus according to the invention has a second single facer **30** which comprises a second grooving roller **31** with a counterpiece **19**. The second grooving roller **31** forms with its counterpiece **19** a nip, into which a second paper web **36** is introduced. The second grooving roller embosses a wave profile onto the second paper web **36**. Furthermore, the second grooving roller **31** has helical grooving **41** (not illustrated).

Moreover, the second paper web **36**, before entry into the nip between the second grooving roller **31** and its counterpiece **19**, is guided via a second oblique guide roller **33**. The second oblique guide roller **33** is inclined at a vertical

inclination angle **40**. The vertical inclination angle **40** of the first and of the second oblique guide roller **23**, **33** are in this case oriented contradirectionally. With respect to the conveying direction of the first paper web **26**, the left side margin of the latter is tautened, and, with respect to the conveying direction of the second paper web **36**, the right side margin of the latter is tautened. Moreover, the second single facer **30** is equipped with a second glue applicator roller **92** which provides the second paper web **36** with adhesive. Furthermore, the second single facer **30** is equipped with an additional glue applicator unit **62** which, in FIG. **7** is not in engagement. The additional glue applicator unit **62** makes it possible to convert the second single facer **30**. The second single facer **30** has a second press-down belt **32** which bears against the second grooving roller **31**. The second paper web **36** provided with a wave profile and the second non-corrugated web **35** are introduced into the nip formed by the second press-down belt **32** and by the second grooving roller **31**. In the nip between the second press-down belt **32** and the second grooving roller, the second non-corrugated web **35** and the second paper web **36** are connected to form a second single-flute corrugated cardboard web **38**. The second single-flute corrugated cardboard web **38** comprises the second non-corrugated web **35** and a second corrugated web **37** which arises from the second paper web **36**. The second single facer **30** has a second web conveying direction **34** in which the second single-flute corrugated cardboard web **38** is conveyed. In this case, the second web conveying direction **34** is codirectional to the running direction **60** of the apparatus according to the invention.

Moreover, the apparatus according to the invention has according to FIG. **7** a third single facer **80** which comprises a third grooving roller **81** and its counterpiece **98**. The third grooving roller **81** and its counterpiece **98** form a nip, into which a third paper web **86** is introduced. The third grooving roller **81** provides the third paper web **86** with a wave profile, the third grooving roller **81** having parallel grooving (not illustrated). Furthermore, the third single facer **80** has a third glue applicator unit **93** which provides the third paper web **86** subjected to a wave profile with adhesive. Furthermore, the third single facer **80** is equipped with an additional glue applicator unit **63** which, in FIG. **7**, is not in engagement. The additional groove applicator unit **63** makes it possible to convert the third single facer **80**. Furthermore, the third single facer has a third press-down belt **82** which is in contact with the third grooving roller **81**. The third press-down belt **82** forms with the third grooving roller **81** a nip, into which the third paper web **86** and a third non-corrugated web **85** are introduced. The third press-down belt **82**, in interaction with the third grooving roller **81**, connects the third non-corrugated web **85** to the third paper web to form a third single-flute corrugated cardboard web **88**. The third single-flute corrugated cardboard web **88** comprises the third non-corrugated web **85** and a third corrugated web **87** which arises from the third paper web **86**. The third single facer **80** has a third web conveying direction **84** in which the third single-flute corrugated cardboard web **88** is conveyed. The third web conveying direction **84** is codirectional to the running direction **60** of the apparatus according to the invention. Moreover, the apparatus according to the invention has according to FIG. **7** a feed roller **56**, via which an additional non-corrugated web **55** is fed. The first single-flute corrugated cardboard web is oriented in such a way that the first corrugated web **27** is opposite the third non-corrugated web **85**. Moreover, the third single-flute corrugated cardboard web **88** is arranged in such a way that the third corrugated web **87** faces the second non-corrugated web **35**. The second single-flute corrugated cardboard web **38** is arranged in such a way that its second corrugated web **37** faces the additional non-corrugated web **25**. The first, the second and the third single-flute corrugated cardboard web **28**, **38**, **88** and the additional non-corrugated web are connected in the arrangement described to form a corrugated cardboard product **90**.

FIG. **8** illustrates the set-up of a corrugated cardboard product according to the invention. This comprises a first, second, third and additional top ply **25**, **85**, **35** and an additional top ply **55**. A first, second and third corrugated web **27**, **37**, **87** are arranged between the top plies **25**, **35**, **85**, **55**. The third corrugated web **87** has in this case a greater flute height than the second and the third corrugated web **27**, **37**. Moreover, head points **72** of the first and the second corrugated web **27**, **37** are connected respectively to the second and third non-corrugated web **35**, **85** in the region of head points **72**. Contact between head and foot points **72** of the corrugated webs **27**, **37**, **87** ensures, under compressive load upon the corrugated cardboard product **90**, a mechanically favorable introduction of force into the third corrugated web **87**. Moreover, the third corrugated web **87** has a wave profile which stands essentially at right angles to side margins **43**, **44** of the corrugated cardboard product **90**. Furthermore, the wave profile of the first corrugated web **27** is offset at an offset angle α and the wave profile of the second corrugated web **37** is offset at an offset angle **3**. The offset angles α, β are in this case oriented contradirectionally. The wave profile **86** of the third corrugated web **87** forms with the wave profiles of the first and the second corrugated web **27**, **37** a symmetrical grid structure. The symmetrical grid structure of the wave profiles ensures a high degree of stiffness of the corrugated cardboard product according to the invention.

LIST OF REFERENCE SYMBOLS

10 Apparatus
18 Counterpiece
19 Counterpiece
20 First single facer
21 First grooving roller
22 First press-down belt
23 First oblique guide roller
24 First web conveying direction
25 First non-corrugated web
26 First paper web
27 Corrugated web
28 First single-flute corrugated cardboard web
29 Axis of rotation grooving roller
30 Second single facer
31 Second grooving roller
32 Second press-down belt
33 Second oblique guide roller
34 Second web conveying direction
35 Second non-corrugated web
36 Second paper web
37 Corrugated web
38 Second single-flute corrugated cardboard web
39 Axis of rotation oblique guide roller
40 Inclination angle
41 Helical grooving
42 Pitch angle
43 Side margin
44 Side margin
50 Deflection

51 Looping angle
52 Deflecting radius
55 Additional non-corrugated web
56 Feed roller
60 Running direction
61 Additional glue applicator unit
62 Additional glue applicator unit
63 Additional glue applicator unit
70 Parting plane
74 First regulating roller
75 Second regulating roller
78 Conveying direction
79 Conveying direction
80 Third single facer
81 Third grooving roller
82 Third press-down belt
83 Glue applicator unit
84 Third web conveying direction
85 Additional non-corrugated web
86 Third paper web
87 Third corrugated web
88 Third single-flute corrugated cardboard web
89 Parallel wave profile
90 Corrugated cardboard product
91 Glue applicator unit
92 Glue applicator unit
93 Glue applicator unit
94 Processing device
95 Processing device
96 First deflecting roller
97 Second deflecting roller
98 Counterpiece
α Offset angle
β Offset angle

The invention claimed is:

1. A method for the production of a corrugated cardboard product by means of an apparatus which is equipped with a first single facer having a first web conveying direction and with a second single facer having a second web conveying direction, comprising the steps: a) production of a first single-flute corrugated cardboard web with a first non-corrugated web and with a first corrugated web in the first single facer, b) production of a second single-flute corrugated cardboard web with a second non-corrugated web and with a second corrugated web in the second single facer, c) bringing of the first single-flute corrugated cardboard web together with the second single-flute corrugated cardboard web, d) connection of the first single-flute corrugated cardboard web to the second single-flute corrugated cardboard web to form a corrugated cardboard product, steps a) and b) comprising in each case a feed of a first and a second paper web to a first and second grooving roller respectively, and the first and second paper web being steered in each case via a vertically inclined guide roller before contact with the first and second grooving roller respectively.

2. The method as claimed in claim **1**, characterized in that the first single facer conveys a first single-flute corrugated cardboard web in the first web conveying direction which is opposite to the second web conveying direction of the second single facer.

3. The method as claimed in claim **1**, characterized in that the first and/or the second paper web is tautened by means of the vertically inclined guide rollers when being drawn in each case into a nip between the grooving rollers and their counterpieces.

4. The method as claimed in claim **1** characterized in that the first grooving roller, by means of helical grooving, provides the first paper web with a wave profile offset at an offset angle α.

5. The method as claimed in claim **1**, characterized in that the second grooving roller, by means of helical grooving, provides the second paper web with a wave profile offset at an offset angle β.

6. The method as claimed in claim **5**, characterized in that the second single-flute corrugated cardboard web is deflected into a running direction of the apparatus by means of a deflection device.

7. The method as claimed in claim **1**, characterized in that, in step d), the corrugated cardboard web of the first single-flute corrugated cardboard web is connected to the second non-corrugated web of the second single-flute corrugated cardboard web.

8. The method as claimed in claim **1**, characterized in that, in step d), the wave profile of the first corrugated web and of the second corrugated web are offset at contradirectional offset angles α, β.

9. The method as claimed in claim **8**, characterized in that the offset angles α, β have identical amounts, and the wave profiles of the first and the second corrugated paper web form a symmetrical grid pattern.

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